Open PhD position
“Soft Membrane Interferometric Stress Sensor”

Funded by the French National Research Agency ANR, we seek one highly motivated individual with a strong interest in pursuing a PhD degree for conducting research on surface forces in soft matter. The candidate must hold a university degree in Physics, Chemical Physics, Material Science, Chemical Engineering or related fields.

Description of the project:

Compliant walls play a significant role in many systems of interest; deformable interfaces abound in systems of biological significance. To understand surface properties of gels (like wetting or adhesion), long-range deformations must be considered. Mammalian synovial joints display remarkable lubrication properties; however, the working mechanisms responsible for that performance, linking charged macromolecules and compliant boundaries, are still not well understood. In that sense, new exploring tools are needed for the precise investigation of the response to external perturbations of compliant boundaries. The main objective of the project is to develop new measuring tools for the precise determination of the deformation of soft surfaces exposed to a changing environment. Using these new tools, a combined theoretical-experimental approach will be implemented to investigate two important topics in soft matter. First, we will explore the electrical double layer at a metal-solution interface and its behavior when it is pushed out of equilibrium. A team associated to the project has recently shown that upon the application of an alternating field, a long-range repulsive force emerges between oppositely charged surfaces separated by ionic solutions. We have theorized that this force is a consequence of the field-induced excess of ions between the surfaces, which results in a non-homogeneous pressure. [1] By using the instrument to be developed, we will explore this scenario and its implications. Second, we will study the elastohydrodynamic EHD coupling emerging when a rigid solid moves near an elastic membrane. A non-conservative EHD lift force was theoretically predicted for an immersed object moving near a compliant wall, as a consequence of the coupling between normal and friction forces due to the deformation of the wall. [2] Two teams associated to this project performed the first direct quantitative measurements of this EHD lift force at the nanoscale. [3], [4] We plan to investigate this important problem for a pair membrane-rigid sphere.

[1] Ł. Richter, P. J. Zuk, P. Szymczak, J. Paczesny, K. M. Bak, T. Szymborski, P. Garstecki, H. A. Stone, R. Hołyst, and C. Drummond, *Ions in an AC Electric Field: Strong Long-Range Repulsion between Oppositely Charged Surfaces*, Phys. Rev. Lett. **125**, 1 (2020).

[2] K. Sekimoto and L. Leibler, *A Mechanism for Shear Thickening of Polymer-Bearing Surfaces: Elasto-Hydrodynamic Coupling*, Europhys. Lett. **23**, 113 (1993).

[3] P. Vialar, P. Merzeau, S. Giasson, and C. Drummond, *Compliant Surfaces under Shear: Elastohydrodynamic Lift Force*, Langmuir **35**, 15605 (2019).

[4] Z. Zhang, V. Bertin, M. Arshad, E. Raphaël, T. Salez, and A. Maali, *Direct Measurement of the Elastohydrodynamic Lift Force at the Nanoscale*, Phys. Rev. Lett. **124**, 54502 (2020).

Applications will be accepted until September 23, 2021. The successful candidate will be granted a 3-year contract. Please submit your application including: CV, a letter describing your research interest and skills, and contact information of two referees, via the CNRS website, https://emploi.cnrs.fr/. For more information, contact:

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